



**TAL
TECH**

SUSTAINABILITY IN CITY PLANNING AND ARCHITECTURE – DESIGN CONSIDERATIONS

Drivers for Wood Construction 2023

Joensuu

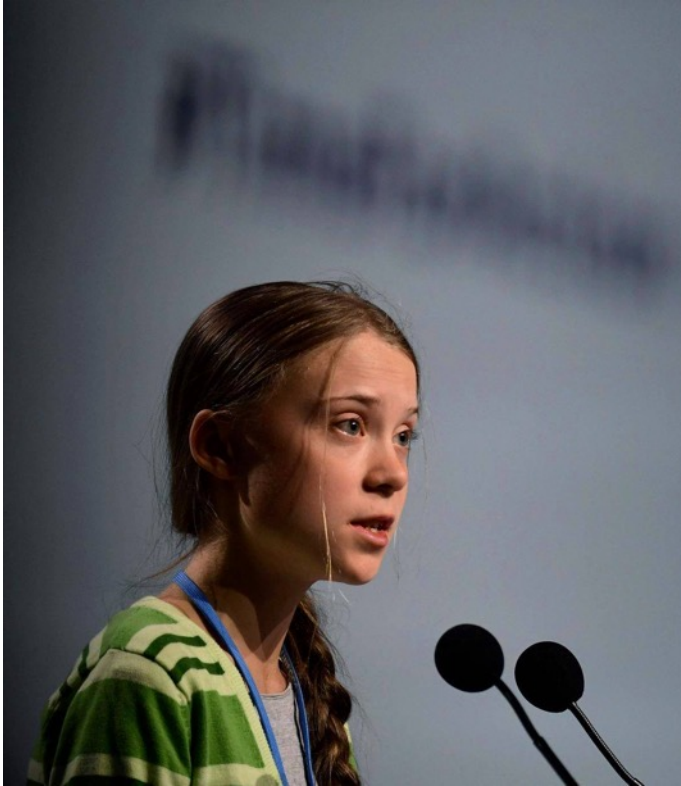
May 15-16 2023

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Tallinn University of Technology

May 15, 2023

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- Introduction
- Buildings
- Cities
- Life cycle properties
- Future wood products



*"I don't want you to listen to me, I want you to **listen to the scientists**. I want you to unite behind the science and I want you to take real action."*

Greta Thunberg
(2003-)

- Climate activist and initiator of school strike for the climate (Fridays for Future) action
- nominated for Nobel Peace Prize both 2019 and 2020

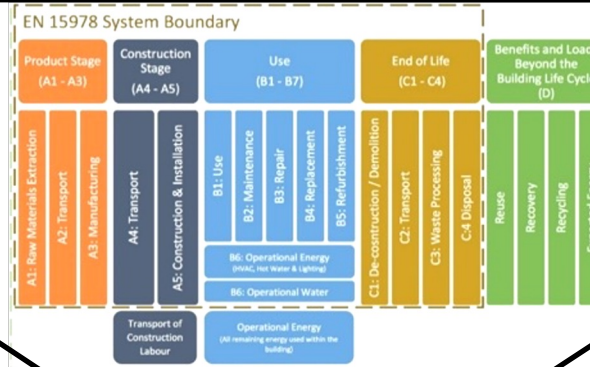


$$\Delta F = a \ln(C/C_0)$$

Svante Arrhenius (1859-1927)

- The first Swedish Nobel laureate: the Nobel Prize for Chemistry 1903
- The first scientist to calculate how changes in CO₂ levels in the atmosphere change the surface temperature through the greenhouse effect

ANALYSIS



297

DESIGN RESPONSE



Verkkosaaren vähähiilinen viherkortteli Helsinki

- Design-and-construct competition in 2020-21
- 50% weighting from numeric indicators (energy efficiency, green factor, carbon footprint)
- multi-disciplinary teams
- Winner team:
 - Hartela Etelä-Suomi Oy
 - Anttinen Oiva
 - Arkkitehdit Oy
 - Nomaji Maisema-arkkitehdit Oy

Image: Anttinen Oiva Arkkitehdit Oy



INDICATORS OF ENVIRONMENTAL PERFORMANCE

Click "+" on the left for more information and "-" to close the window.



USER INPUTS

Insert surface areas from Your competition entry, save and print to attach the results to the competition material.

FLOOR PLAN EFFICIENCY

Total net floor area m²

SHAPE FACTOR

Building envelope surface area m² +

Floor surface area m²

Intermediate floor area m²

Window and glass wall area m²

Door surface area m²

Exterior wall area without openings m²

Roof surface area m²

Building envelope area total m²

Scroll down to specify the materials and the PV surface area.

RESULTS



FLOOR PLAN EFFICIENCY

$A_{\text{floor area, entry}} / A_{\text{programmed floor}}$



SHAPE FACTOR

$A_{\text{envelope}} / A_{\text{programmed floor area}}$



CARBON FOOTPRINT

(1000 tCO₂e)



PV OUTPUT

(MWh/a)

PRINT

SAVE AS XLS

SAVE IN LOG

HELP

LIGHT TIMBER FRAME

CLT FRAME

CONCRETE FRAME

BRICK WALL

RESET PV

name of the competition entry:

TEST DESIGN

Check inputs! The total net floor area of the entry is currently smaller than the total programmed area.
Are all the spaces included?

USER VIEW

PRINT VIEW

DEFAULTS

DATABASE

CALCULATOR

LANGUAGES

LOG

HELP



GHG ACCOUNTING FOR CITIES AND REGIONS

Two complementary approaches

ALTERNATIVE ALLOCATION PRINCIPLES:

TERRITORIAL APPROACH

- **Today, most regions and cities apply territorial approach that assesses the direct greenhouse gas emissions within the geographic boundaries of the area of assessment, for example the city boundary.**

CONSUMPTION-BASED APPROACH

- **A consumption-based approach aims to assess the global greenhouse gas emissions of the local residents.**

Currently, the best practise is to apply both of these approaches.

STATE-OF-THE-ART

- **The GHG quantification methods for regions and cities are not harmonized (see for example Loiseau 2012, Dahal & Niemelä 2014, Seto 2014)**
- **Consumption-based GHG accounting (CBA) is gaining more and more foothold but is not likely to replace territorial GHG accounting approach (Afionis et al. 2017)**

RECENT DEVELOPMENTS

Open data

From third-party statistical datasets towards case-specific data collection

Automatisation of data collection

Real time economy

From annual reporting towards continuous monitoring

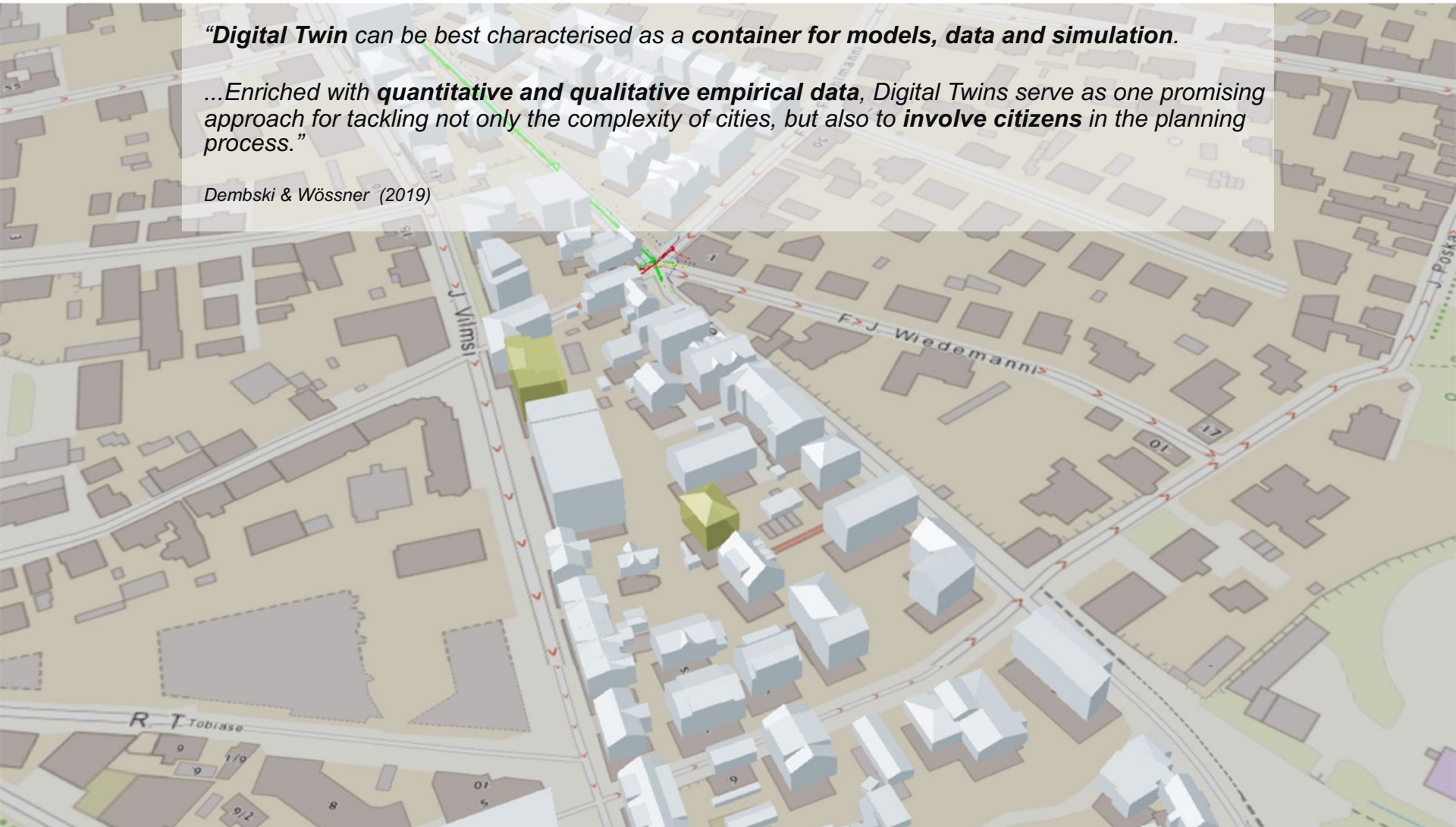
Embodied emissions

Material-related emissions can be quantified with high precision due to BIM and building CF practice

"Digital Twin can be best characterised as a **container for models, data and simulation.**

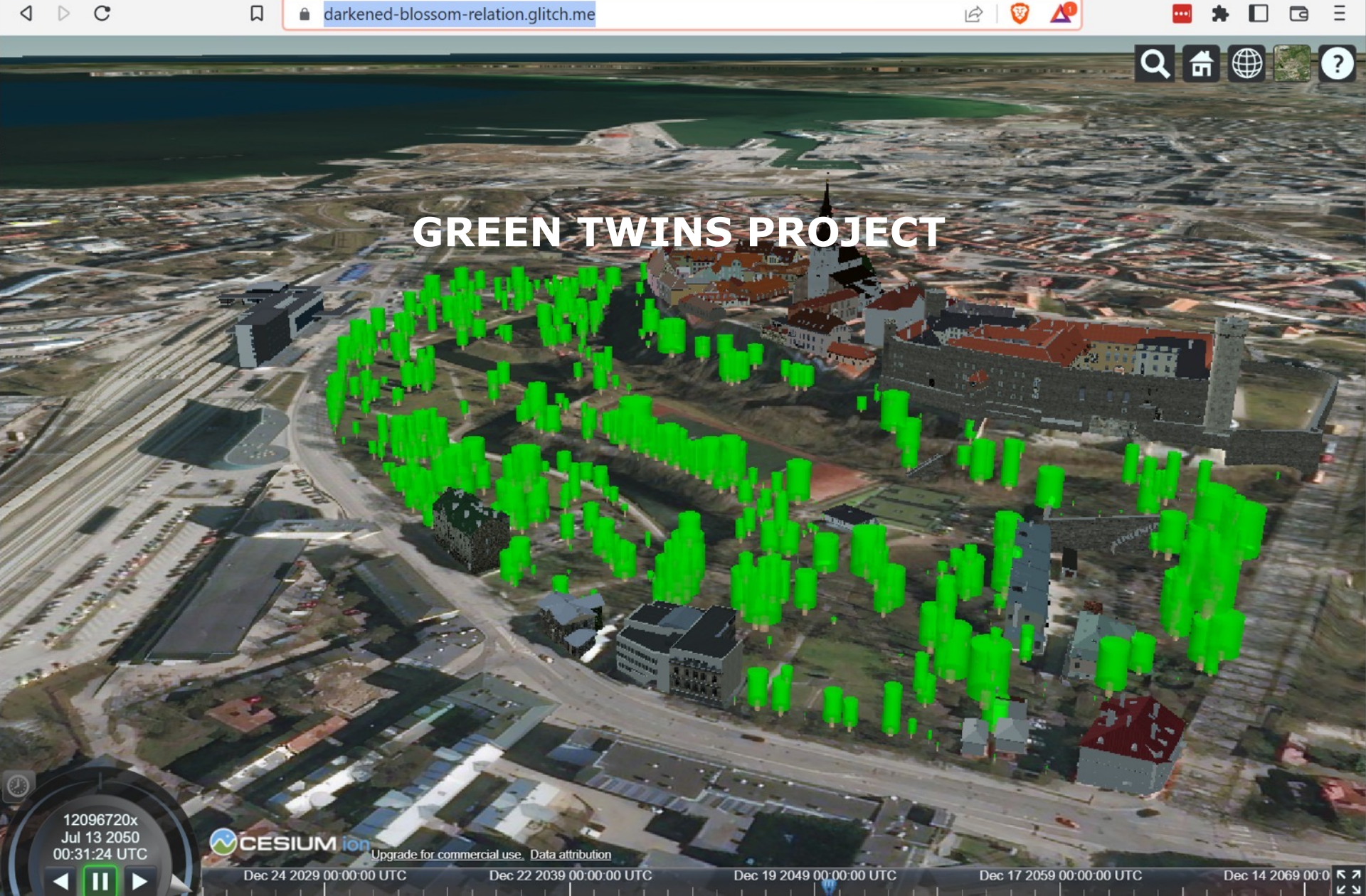
...Enriched with **quantitative and qualitative empirical data**, Digital Twins serve as one promising approach for tackling not only the complexity of cities, but also to **involve citizens** in the planning process."

Dembski & Wössner (2019)

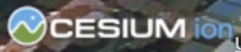




GREEN TWINS PROJECT



12096720x
Jul 13 2050
00:31:24 UTC



Upgrade for commercial use. Data attribution

Dec 24 2029 00:00:00 UTC

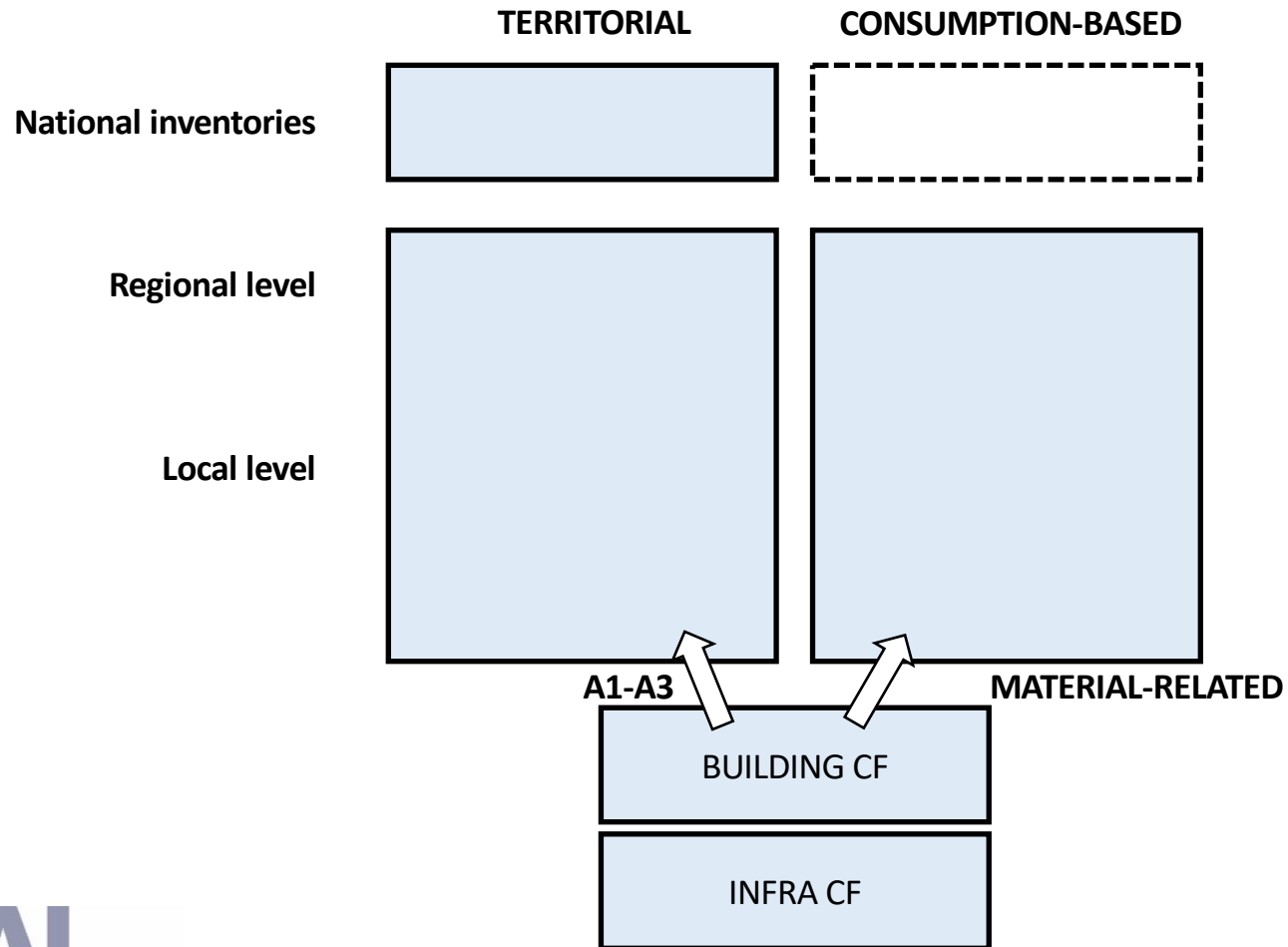
Dec 22 2039 00:00:00 UTC

Dec 19 2049 00:00:00 UTC

Dec 17 2059 00:00:00 UTC

Dec 14 2069 00:00:00 UTC





LIFE CYCLE PROPERTIES

RL39§

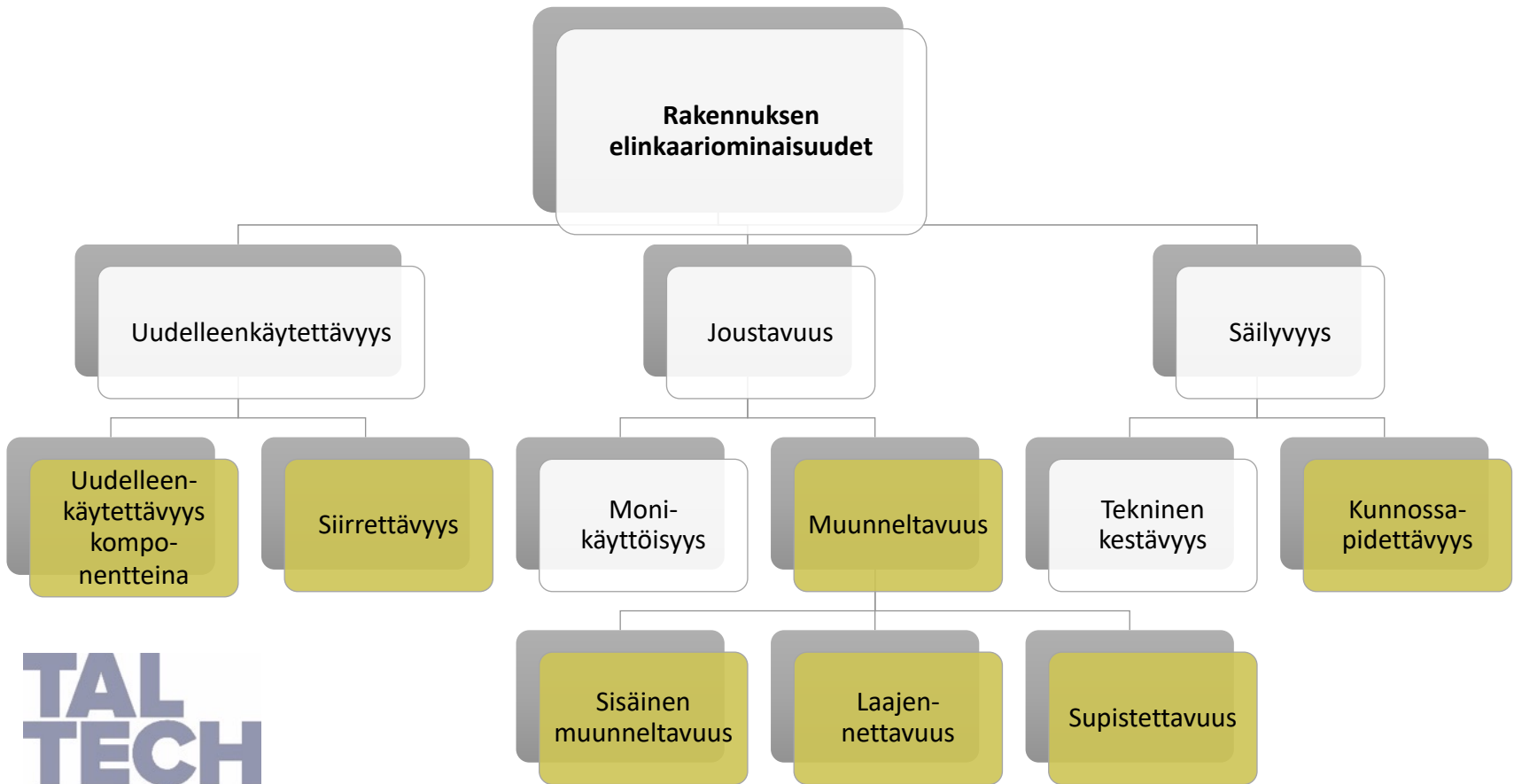
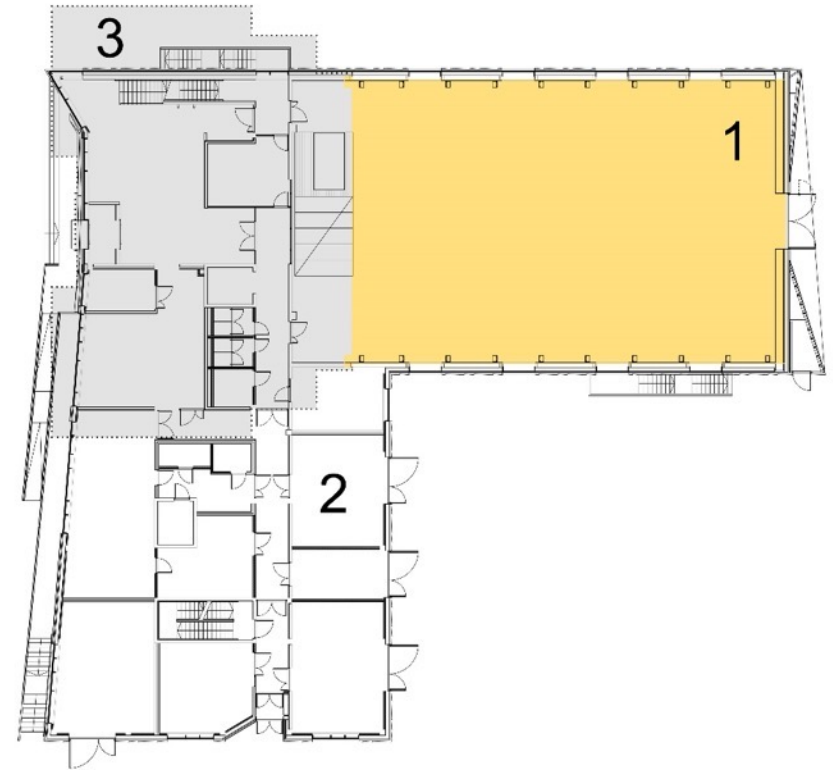
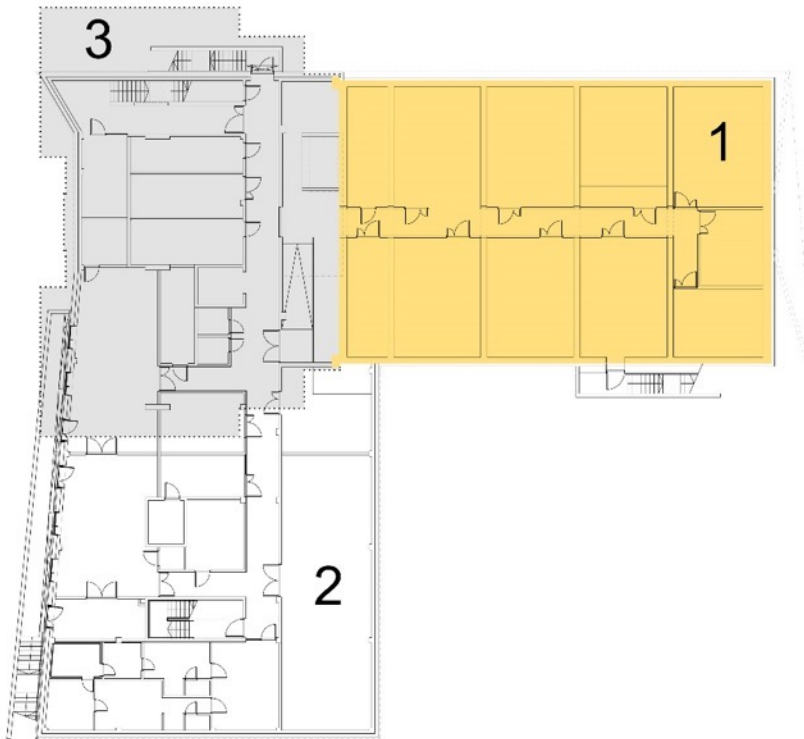




photo: Vallo Vaheäär



- 1 DEMOLISHED**
- 2 NEW (OFFICES)**
- 3 MAINTAINED (TEST HALL)**

Address	Harju county, Tallinn, Mustamäe district, Mäepealse tn 3
Architect	Tõnu Laigu, Allis Mehide, Kristjan Lind
Interior architect	Tarmo Piirmets
Landscape architects	Kadi Nigul, Kristian Nigul
Lighting designer	Marko Kuusik
Year of completion	2021



photo: Tõnu Laigu)

CIRCULARITY ASSESSMENT

Circularity index – four variables

1. type of connections
2. accessibility of connections
3. Crossings
4. form containment.

Kalle Kuusk, Michiel Ritzen, Patrick Daly, Dimitra Papadaki, Cecilia Mazzoli, Guzide Aslankaya, Jure Vetršek, Targo Kalamees (2022). **The circularity of renovation solutions for residential buildings**. In Conference Proceedings. REHVA 14th HVAC World Congress 22nd-25th May, Rotterdam, The Netherland.

Model based on: Alba Concepts (Accessed: 8 March 2022). Available at:
<https://albaconcepts.nl/circulairbouwen/>

CIRCULARITY ASSESSMENT

Tab. 10 – Circularity of renovation solutions.

	Type of Connection	Accessibility of connection	Crossings	Form containment	Materials	Circularity index	Degree of circularity
Dutch (2D prefab)	0.68	0.87	0.83			0.80	high
Estonian (2D prefab)	0.83	0.83	1.00	0.83	0.42	0.78	medium
Greek (ETICS)	0.50	0.10	1.00	0.10	0.10	0.36	low
Irish (2D prefab)	0.84	0.64	1.00	0.83	0.44	0.75	medium
Italian (2D prefab)	0.71	0.88	1.00	0.70	0.54	0.77	medium
Italian (ETICS)	0.27	0.40	0.10	0.10	0.43	0.26	low
Slovenian (ETICS)	0.27	0.40	0.83	0.10	0.10	0.34	low
Spanish (PV facade)	0.82	0.85	1.00	0.82	0.49	0.79	medium

Kalle Kuusk, Michiel Ritzen, Patrick Daly, Dimitra Papadaki, Cecilia Mazzoli, Guzide Aslankaya, Jure Vetršek, Targo Kalamees (2022). **The circularity of renovation solutions for residential buildings.** In Conference Proceedings. REHVA 14th HVAC World Congress 22nd-25th May, Rotterdam, The Netherlands.

LIFE CYCLE PROPERTIES RL39§

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FUTURE TIMBER SOLUTIONS MORE INTELLIGENCE, LESS PROCESSING

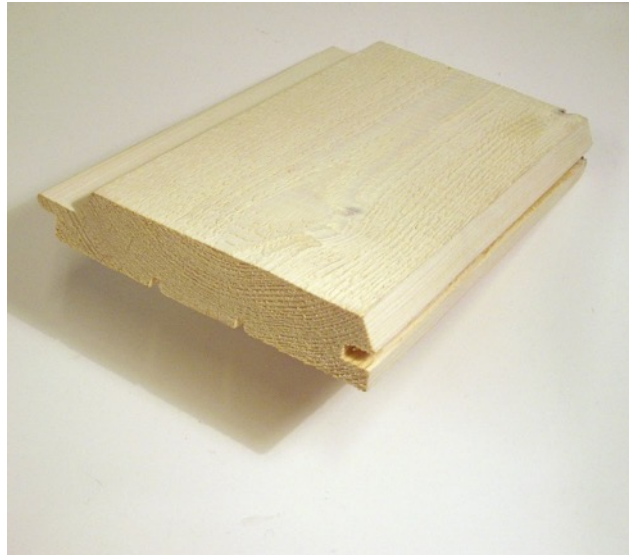
Cellulose insulation
dampsprayed



Thermal insulation material
of wood chips and clay
(instead of boron)



FUTURE TIMBER SOLUTIONS: PREVENT PROBLEMATIC WASTE IN END-OF-LIFE

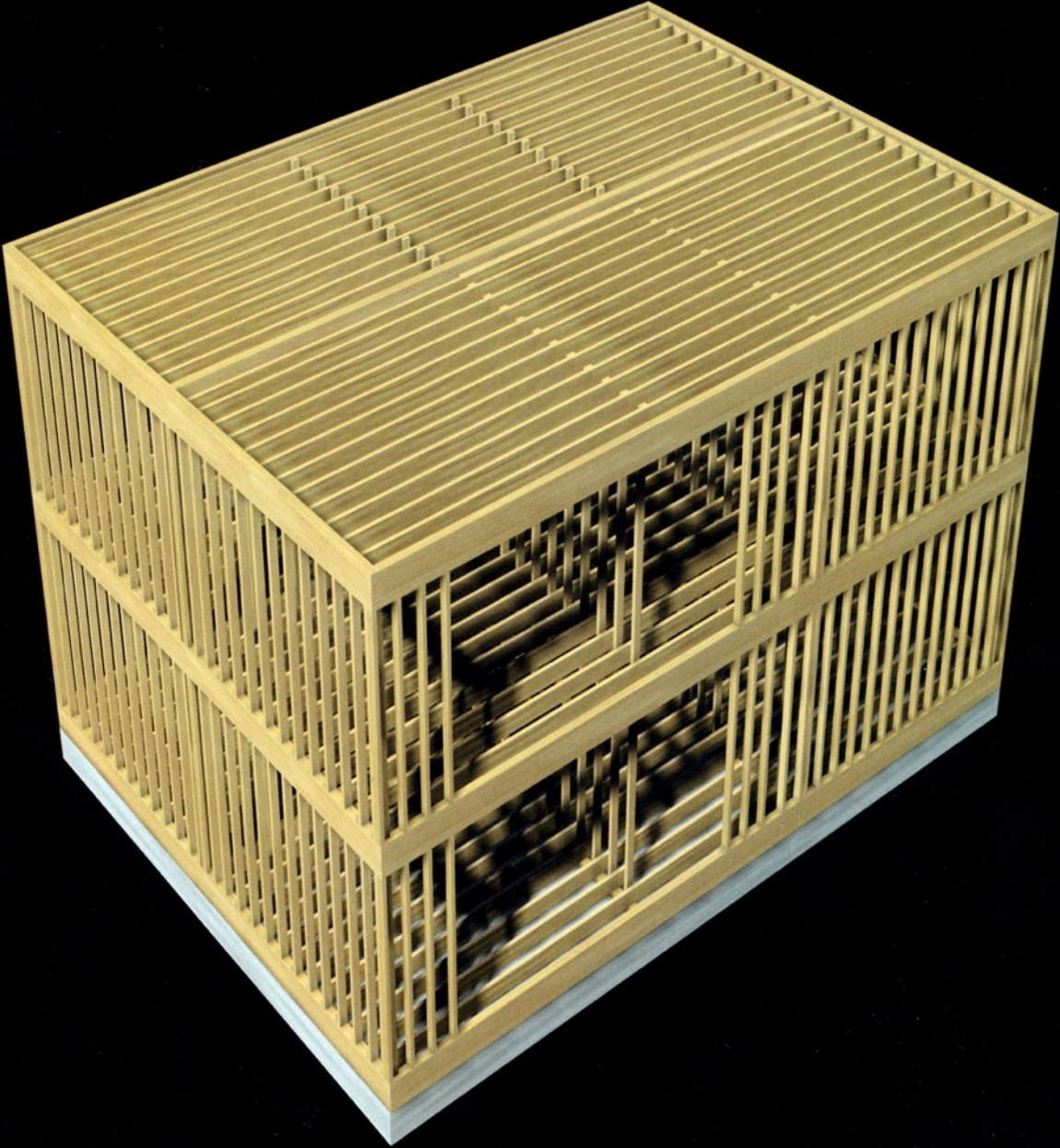


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FUTURE TIMBER SOLUTIONS: CREATE COMPONENT REUSE POTENTIAL



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FUTURE TIMBER SOLUTIONS: HIGH PERFORMANCE WITH MINIMUM MATERIAL USE



Frei Otto: Mannheim Multihalle



"To accomplish a task with the minimum of material is finally the only interesting problem."

Bernard Lafaille (1900-1955)

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THANK YOU FOR YOUR ATTENTION

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May 15, 2023